Entry

How is the market structure determined in an industry? (number of firms, market shares, etc.)

- Entry until profit equals zero
    - But what with all the *positive profits* we observe?

- Regulations
    - But what with *deregulations* over the last decades?

- Technology
    - Economies of scale → natural monopoly

- Vertical product differentiation
    - natural oligopoly

- *The established (incumbent) firms' strategic advantage*

Three strategies when confronted with an entry threat

- Blockading entry: "business as usual"

- Deterring entry: Established firms act in such a way that entry is sufficiently unattractive

- Accommodating entry

Technology vs. strategic advantages

What kind of fixed costs?

- Irreversible/Sunk costs: Strategic advantage
- Reversible fixed costs: Economies of scale

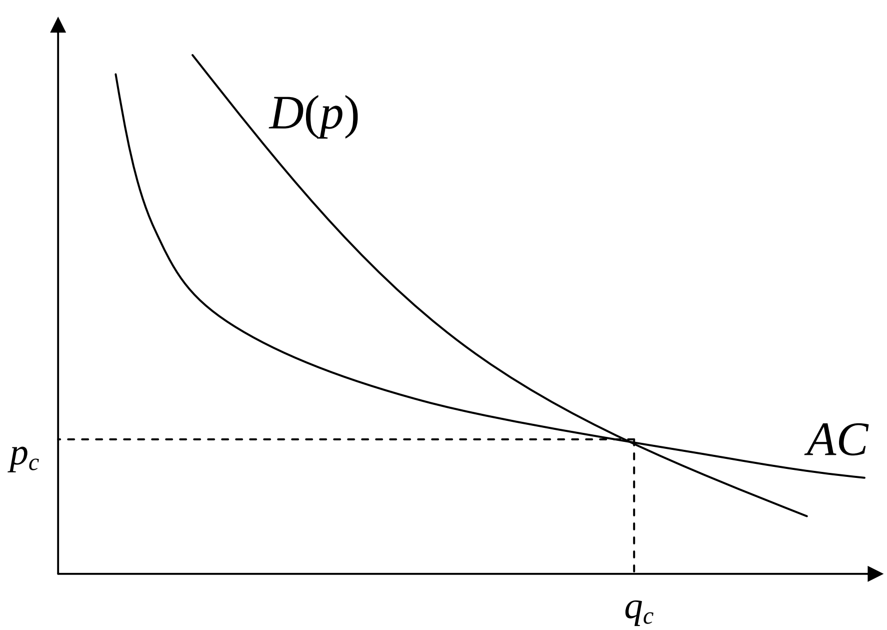
Contestability theory

Main thesis: economies of scale give only a limited advantage for the established firm

Suppose costs are:

$$C(q) = \begin{cases} cq + f, & \text{if } q > 0, \\ 0, & \text{otherwise} \end{cases}$$

(reversible fixed costs)



The incumbent firm sets price p_c and quantity q_c.

This situation is *sustainable* in equilibrium because

- any $p < p_c$ by another firm yields a loss
- any $p > p_c$ by the incumbent firm entails entry

What game is played here?

- Prices before quantities?

- Short-term commitment of capacity; "hit-and-run entry".
  - Short-term commitment means a small strategic advantage.
  - If another firm enters, then the incumbent wants to leave as soon as possible.
  - In order to prevent such entry, the incumbent may want to set $q > q^m$.
  - As the commitment period shrinks to zero, $q \to q_c$. [Tirole, pp. 340-341]

The strategic advantage of being incumbent

- a simple model
- a general analysis of business strategies

How to treat an entry threat? A simple model

Two-stage game: Sequential moves.

Stage 1: Incumbent (firm 1) chooses capacity.

Stage 2: Potential entrant (firm 2) chooses capacity;
zero capacity = no entry.

Profit functions (gross of any entry costs):

$$\pi^1(K_1, K_2) = K_1(1 - K_1 - K_2)$$
$$\pi^2(K_1, K_2) = K_2(1 - K_1 - K_2)$$

K_i = capacity choice of firm i.

$$\frac{\partial^2 \pi^i}{\partial K_1 \partial K_2} < 0$$

Case (i): No entry costs (Stackelberg 1934)

<u>Accommodated entry</u>

Stage 2: $\frac{\partial \pi^2}{\partial K_2} = 1 - K_1 - 2K_2 = 0$

$$\rightarrow K_2 = R_2(K_1) = \frac{1-K_1}{2}$$

Stage 1: $\pi^1 = K_1[1 - K_1 - K_2] = K_1[1 - K_1 - \frac{1-K_1}{2}]$

$$= \frac{K_1(1-K_1)}{2}$$

$$\rightarrow \quad K_1^s = \frac{1}{2}; \quad K_2^s = R_2(\frac{1}{2}) = \frac{1}{4}.$$

$$\pi^1 = \frac{1}{8}; \quad \pi^2 = \frac{1}{16}.$$

Comparison: Simultaneous moves – Cournot.

$$K_1 = R_1(K_2) = \frac{1-K_2}{2}$$

$$K_2 = R_2(K_1) = \frac{1-K_1}{2}$$

$$\rightarrow K_1 = K_2 = \frac{1}{3}; \quad \pi^1 = \pi^2 = \frac{1}{9}.$$

Case (ii): Entry costs

f = entry costs.

Entry cost not relevant for firm 1 – sunk cost.

Profit function of firm 2 net of entry costs:

$$\pi^2(K_1, K_2) \begin{cases} = K_2(1 - K_1 - K_2) - f, & \text{if } K_2 > 0; \\ = 0, & \text{if } K_2 = 0. \end{cases}$$

<u>Blockaded entry</u>: $K_2 = 0$.

Stage 1: max $\pi^1(K_1, 0) = K_1(1 - K_1)$.

$$\rightarrow K_1^m = \frac{1}{2}.$$

But when is $K_2 = 0$ the best response to $K_1 = \frac{1}{2}$?

Stage 2: $K_2 = \begin{cases} R_2(\frac{1}{2}) = \frac{1}{4}, \text{ or} \\ 0. \end{cases}$

Profit is:

$$\pi^2 = \begin{cases} \pi^2(\frac{1}{2}, \frac{1}{4}) = \frac{1}{16} - f, \text{ or} \\ 0. \end{cases}$$

$\rightarrow$ Entry is blockaded if: $f \geq \frac{1}{16} \approx 0.063$.

Deterred entry

Which stage-1 quantity makes firm 2 indifferent between entry and no entry? K_1^b
If $K_1 \geq K_1^b$, then firm 2 chooses no entry.

Stage 2: $\max_{K_2} K_2(1 - K_1^b - K_2) - f$

$$\rightarrow K_2 = \frac{1-K_1^b}{2}.$$

$$\rightarrow \pi_{\max}^2 = [\frac{1-K_1^b}{2}]\{1 - K_1^b - [\frac{1-K_1^b}{2}]\} - f$$

$$\pi_{\max}^2 = 0 \rightarrow K_1^b = 1-2\sqrt{f}$$

Stage 1:

$$f \geq \frac{1}{16} \rightarrow$$

$K_1^b \leq K_1^m$, and firm 1 prefers K_1^m to K_1^b; blockaded entry.

$$f < \frac{1}{16} \rightarrow$$

By setting $K_1 = K_1^b$, firm 1 deters entry and earns:

$$\begin{aligned}\pi^1(K_1^b, 0) &= K_1^b[1 - K_1^b] \\ &= (1-2\sqrt{f})[1 - (1-2\sqrt{f})] \\ &= 2\sqrt{f} - 4f\end{aligned}$$

Alternatively, firm 1 can accommodate entry and earn $\frac{1}{8}$ (Stackelberg).

→ Entry deterrence better than entry accommodation when:

$$\pi^1(K_1^b, 0) > \frac{1}{8}$$

$$2\sqrt{f} - 4f > \frac{1}{8}$$

$$\Leftrightarrow f - \frac{1}{2}\sqrt{f} + \frac{1}{32} < 0$$

$$\Leftrightarrow f - \frac{1}{2}\sqrt{f} + \frac{1}{16} < \frac{1}{32}$$

$$\Leftrightarrow \left(\sqrt{f} - \frac{1}{4}\right)^2 < \frac{1}{32}$$

[We are interested in the case $f < 1/16$, that is, $\sqrt{f}$ – 1/4 < 0. Taking squares, we are interested in the absolute value of $\sqrt{f}$ - 1/4, that is 1/4 – $\sqrt{f}$. So:

$$\Leftrightarrow \frac{1}{4} - \sqrt{f} < \frac{1}{4\sqrt{2}} \quad \Leftrightarrow \quad \sqrt{f} > \frac{1}{4}\left(1 - \frac{1}{\sqrt{2}}\right)]$$

$$\Leftrightarrow f > \frac{1}{16}\left(1 - \frac{1}{\sqrt{2}}\right)^2 = \frac{1}{16}\left(\frac{3}{2} - \sqrt{2}\right) \approx 0.0054$$

→ What the incumbent chooses to do in face of an entry threat depends on the entry costs:

(i) Low entry costs imply *accommodated entry*:

$$f \in [0, \frac{1}{16}\left(\frac{3}{2} - \sqrt{2}\right)]$$

$K_1 = 1/2$, $K_2 = 1/4$.

(ii) Medium-sized entry costs imply *deterred entry*:

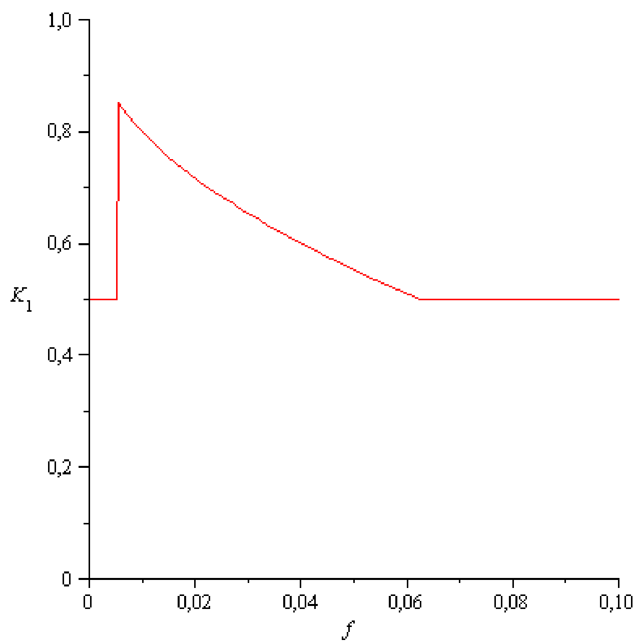
$$f \in (\frac{1}{16}\left(\frac{3}{2} - \sqrt{2}\right), \frac{1}{16})$$

$K_1 = 1 - 2\sqrt{f}$, $K_2 = 0$.

(iii) High entry costs imply *blockaded entry*:

$$f \geq \frac{1}{16}$$

$K_1 = 1/2$, $K_2 = 0$.



How to treat an entry threat? A more general model

Two firms:
firm 1 – the incumbent
firm 2 – the potential entrant

Stage 1:
Firm 1 chooses K_1.
Firm 2 decides whether or not to enter.

Stage 2:
Either:
(i) firm 1 is a monopolist,
or:
(ii) both firms are in the market and choose their stage-2 variables x_1 and x_2 simultaneously.

Stage-2 equilibrium:

$$\{x_1(K_1), x_2(K_1)\}$$

Comparative statics

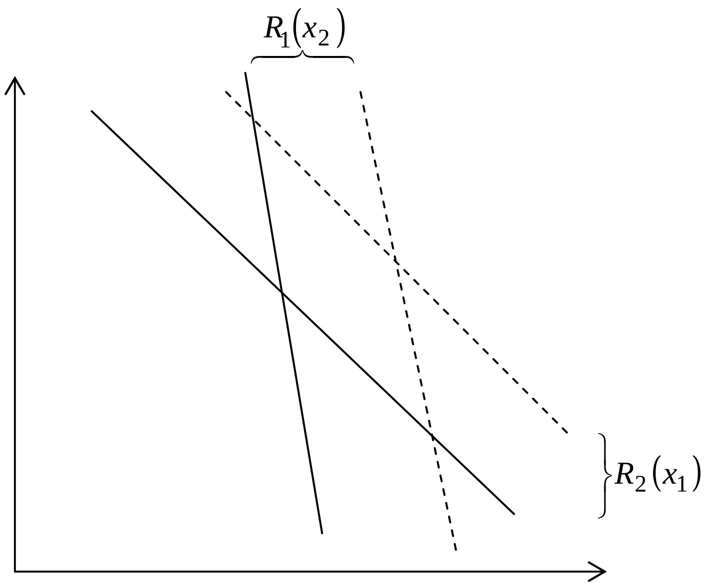
How is stage-2 equilibrium affected by the incumbent's stage-1 move K_1?

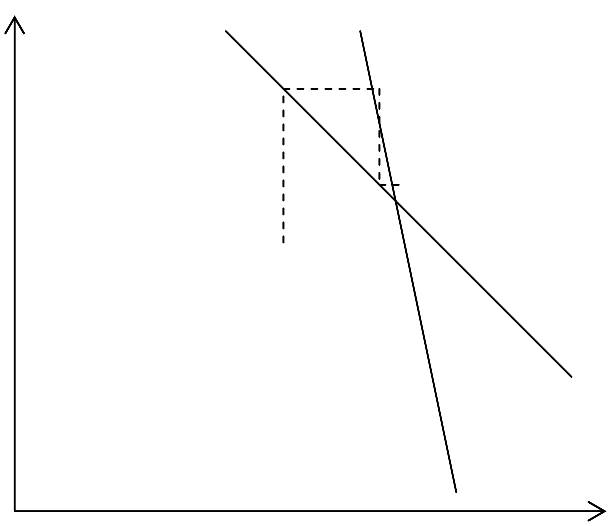
Can we apply comparative statics to an equilibrium?

- uniqueness
- stability

<u>Stability</u>: dynamic reasoning in a static model

If the stage-2 game changes, then also the stage-2 equilibrium changes. But will the model stabilize at the new equilibrium?





Stability condition:

"R_1 crosses R_2 from above"

or: R_1 steeper than R_2, as we see them.

$$-\frac{1}{R_1'(x_2^*)} > -R_2'(x_1^*)$$

$$\Leftrightarrow R_1'(x_2^*)\, R_2'(x_1^*) < 1$$

$$\Leftrightarrow \frac{\partial^2\pi^1 / \partial x_1 \partial x_2}{\partial^2\pi^1 / \partial x_1^2} \frac{\partial^2\pi^2 / \partial x_1 \partial x_2}{\partial^2\pi^2 / \partial x_2^2} < 1$$

$$\Leftrightarrow \frac{\partial^2\pi^1}{\partial x_1^2}\frac{\partial^2\pi^2}{\partial x_2^2} - \frac{\partial^2\pi^1}{\partial x_1 \partial x_2}\frac{\partial^2\pi^2}{\partial x_1 \partial x_2} > 0$$

Firms' stage-2 profits:
$\pi^1(K_1, x_1^*(K_1), x_2^*(K_1))$ and
$\pi^2(K_1, x_1^*(K_1), x_2^*(K_1))$

What does firm 1 do at stage 1?

- If $\pi^2(K_1, x_1^*(K_1), x_2^*(K_1)) \leq 0$, then firm 1 has made a choice of K_1 at stage 1 that *deters entry*.

- If $\pi^2(K_1, x_1^*(K_1), x_2^*(K_1)) > 0$, then firm 1 has made a choice of K_1 at stage 1 that *accommodates entry*.

Entry deterrence

In order to deter entry, firm 1 must set K_1 such that $\pi^2 = 0$. What is the effect on π^2 of a change in K_1?

$$\pi^2 = \pi^2(K_1, x_1^*(K_1), x_2^*(K_1))$$

$$\frac{d\pi^2}{dK_1} = \frac{\partial \pi^2}{\partial K_1} + \frac{\partial \pi^2}{\partial x_1}\frac{dx_1^*}{dK_1} + \underbrace{\frac{\partial \pi^2}{\partial x_2}}_{=0}\frac{dx_2^*}{dK_1}$$

$$\frac{d\pi^2}{dK_1} = \underbrace{\frac{\partial \pi^2}{\partial K_1}}_{\text{direct effect}} + \underbrace{\frac{\partial \pi^2}{\partial x_1}\frac{dx_1^*}{dK_1}}_{\text{strategic effect}}$$

Stage-1 choices with a direct effect:

- location
- advertising
- *not* capacity

Firm 1 wants π^2 so low that $\pi^2 = 0$.

- If $d\pi^2/dK_1 < 0$, then $\pi^2 = 0$ is obtained by increasing K_1, that is, by being big. The strategy is to look aggressive by being big: the <u>top dog strategy</u>

- If $d\pi^2/dK_1 > 0$, then $\pi^2 = 0$ is obtained by reducing K_1, that is, by being small. The strategy is to look aggressive by being small: the <u>lean-and-hungry-look strategy</u>

Entry accommodation

The optimum choice for firm 1 at stage 1 is such that firm 2's profit after entry is positive:

$$\pi^2(K_1, x_1^*(K_1), x_2^*(K_1)) > 0$$

Since entry is inevitable, firm 1 seeks to maximize *own* profit, given entry by firm 2.

$$\pi^1 = \pi^1(K_1, x_1^*(K_1), x_2^*(K_1))$$

$$\frac{d\pi^1}{dK_1} = \frac{\partial \pi^1}{\partial K_1} + \underbrace{\frac{\partial \pi^1}{\partial x_1}}_{=0} \frac{dx_1^*}{dK_1} + \frac{\partial \pi^1}{\partial x_2} \frac{dx_2^*}{dK_1}$$

$$\frac{d\pi^1}{dK_1} = \underbrace{\frac{\partial \pi^1}{\partial K_1}}_{\text{direct effect}} + \underbrace{\frac{\partial \pi^1}{\partial x_2} \frac{dx_2^*}{dK_1}}_{\text{strategic effect}}$$

Suppose $\frac{\partial \pi^1}{\partial K_1} = 0$: no direct effect

The strategic effect

Assume firms' stage-2 actions are symmetric: one firm's effect on the other firm's profit is qualitatively the same for the two firms.

$$sign\left(\frac{\partial \pi^1}{\partial x_2}\right) = sign\left(\frac{\partial \pi^2}{\partial x_1}\right)$$

From the chain rule:

$$\frac{dx_2^*}{dK_1} = \frac{dx_2^*}{dx_1}\frac{dx_1^*}{dK_1} = R_2'\left(x_1^*\right)\frac{dx_1^*}{dK_1}$$

$\Rightarrow$

$$sign\underbrace{\left(\frac{\partial \pi^1}{\partial x_2}\frac{dx_2^*}{dK_1}\right)}_{\substack{\text{strategic effect,}\\ \text{entry accommodation}}} = sign\underbrace{\left(\frac{\partial \pi^2}{\partial x_1}\frac{dx_1^*}{dK_1}\right)}_{\substack{\text{strategic effect,}\\ \text{entry deterrence}}} \cdot sign\underbrace{\left(R_2'\right)}_{\substack{\text{slope}\\ \text{best-}\\ \text{response}\\ \text{curve}}}$$

(i) Stage-2 variables are <u>strategic substitutes</u>: $R_2' < 0$.

Example: quantity competition at stage 2.

$$sign\left(\frac{\partial \pi^1}{\partial x_2}\frac{dx_2^*}{dK_1}\right) = -sign\left(\frac{\partial \pi^2}{\partial x_1}\frac{dx_1^*}{dK_1}\right)$$

If an increase in K_1 *reduces* π^2, then it *increases* π^1.

If an increase in K_1 *increases* π^2, then it *reduces* π^1.

With strategic substitutes, entry accommodation and entry deterrence are the same thing.

It is good for firm 1 to be aggressive at stage 1, also when it *accommodates entry*.

The strategy is, either:

to look aggressive by being big:
the <u>top-dog strategy</u>,

or

to look aggressive by being small:
the <u>lean-and-hungry-look strategy</u>

(ii) Stage-2 variables are strategic complements: $R_2' > 0$.

Example: price competition at stage 2.

$$sign\left(\frac{\partial \pi^1}{\partial x_2}\frac{dx_2^*}{dK_1}\right) = sign\left(\frac{\partial \pi^2}{\partial x_1}\frac{dx_1^*}{dK_1}\right)$$

If an increase in K_1 *reduces* π^2, then it also *reduces* π^1.

If an increase in K_1 *increases* π^2, then it also *increases* π^1.

An entry-accommodating incumbent firm now wants to be non-aggressive!

If firm 1 becomes aggressive when K_1 is large, then it now wants to keep K_1 down in order to look non-aggressive: the puppy-dog strategy.

If firm 1 becomes aggressive when K_1 is small, then it now wants to have a high K_1 in order to look non-aggressive: the fat-cat strategy.

Business strategies

I. Entry deterrence

Incumbent looks aggressive when investment is	
big	small
Top Dog	**Lean and Hungry Look**

II. Entry accommodation

	Incumbent looks aggressive when investment is	
	big	small
strategic complements	**Puppy Dog**	**Fat Cat**
strategic substitutes	**Top Dog**	**Lean and Hungry Look**

Applications:

i) Two-stage model:
   1) capacities
   2) prices

Prices strategic complements.

Large capacity makes a firm aggressive.

$\rightarrow$ Puppy dog strategy: Install a rather small capacity in order to soften the ensuing price competition

ii) Location model:
   1) location
   2) prices

Again: prices are strategic complements

Interpret K_1 as closeness to the centre.

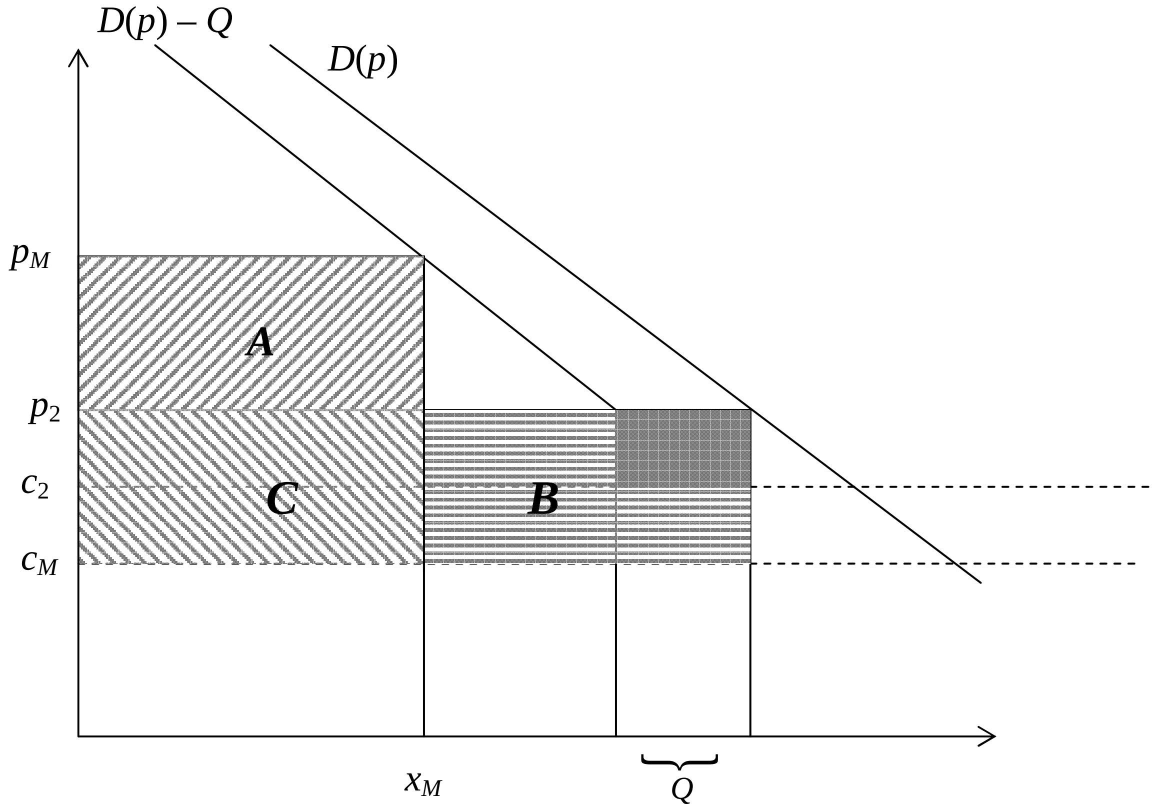
$\rightarrow$ Puppy dog strategy: Locate far away from the centre in order to soften the ensuing price competition

iii) Puppy-dog entry

Stage 1: Entrant decides capacity and price
Stage 2: Incumbent decides price

Incumbent's options:

- monopoly on residual market: $\pi = A + C$
- undercut and get the whole market: $\pi = B + C$



Entrant's optimum decision: Choose p and Q such that $A > B$.

[Gelman and Salop, "Judo Economics: Capacity Limitation and Coupon Competition", *Bell Journal of Economics* 14 (1983), 315-325]

A Norwegian example: Viking Cement, 1983.

[Sørgard, "A Consumer as an Entrant in the Norwegian Cement Market", *Journal of Industrial Economics*, 41 (1993), 191-204]

iv) Persuasive advertising

Stage 1: Incumbent invests in loyalty-inducing advertising

Stage 2: Price competition (if entry)

Entry deterrence: look aggressive

High investments → Many loyal firm-1 customers in stage 2 → High price by firm 1

⇒ Lean and Hungry Look: In order to deter entry, the incumbent firm keeps its advertising low in order to keep post-entry prices, and therefore firm 2's post-entry profit, low.

Entry accommodation: look non-aggressive

Firm 1 wants to have many loyal customers, so that its incentives to set a low price in stage 2 are weak.

⇒ Fat Cat strategy

Example: the Norwegian ice-cream market 1992

NM (Norske Meierier) vs GB.
High level of advertising by NM. Not because NM wanted to keep GB out, but because it wanted to keep GB's prices high (Fat Cat).